EXHIBIT 1

FRANK RISK SOLUTIONS

August 29, 2016

Expert Report
Of
W. L. Frank, P.E.

My Qualifications:

My name is Walter L. Frank and I am President of Frank Risk Solutions, Inc. I am a process safety consultant and one of my areas of specialization is the evaluation and control of fire and explosions hazards associated with combustible dusts. My work experience includes 24 years with DuPont, including ten years in the Process Safety and Fire Protection group in the DuPont Engineering Services Division, where I was the primary contact for matters dealing with combustible dust safety. After DuPont, I was a process safety consultant with ABS Consulting for ten years, retiring to form Frank Risk Solutions in 2007.

I am a registered Professional Engineer in the state of Delaware and a Fellow of both the American Institute of Chemical Engineers (AIChE), and the AIChE Center for Chemical Process Safety (CCPS). I am a member of the National Fire Protection Association (NFPA) and I have served on the NFPA Technical Committee on Handling and Conveying of Dusts, Vapors, and Gases for 21 years, previously chairing the committee for ten years. This committee has responsibility for three important combustible dust safety standards, including NFPA 654, *Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids* and NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids*. I am also a member of the NFPA Technical Committee on Fundamentals of Combustible Dusts and a member of the Combustible Dusts Technical Correlating Committee which has oversight responsibility for the various NFPA combustible dust standards.

I have co-authored four books on process safety topics for CCPS, and I am currently the CCPS staff consultant responsible for a project to develop a guideline book on *Essential Practices for the Control and Mitigation of Dust Hazards*. I was a contributing author for the process safety section of the current edition of Perry's Chemical Engineer's Handbook and I recently co-authored the *NFPA® Guide to Combustible Dusts*. I have taught combustible dust safety continuing education courses for ABS Consulting, AIChE, and NFPA. My Curriculum Vitae is provided in Attachment A.

Background:

On October 9, 2012, one or more fires occurred in the premix room of a printing ink manufacturing facility owned by US Ink and/or Sun Chemical Corporation (Sun), in East Rutherford, NJ. These events occurred on the second day of operation of a newly installed dust collection system. This system was provided to capture dust that would otherwise be released from processing equipment associated with the ink manufacturing operations.

During the event, inappropriate fire-fighting efforts, specifically the improper use of a fire extinguisher, led to a flash fire which caused burn injuries to seven workers.

My report does not offer opinions on the detailed causation of the event. My report addresses Sun's deficiencies in the application of process safety management principles, and its failures to adhere to relevant requirements established by industry standards and Sun's own company standards and procedures.

The Importance of Process Safety Management

My report addresses, *inter alia*, Sun's failure to implement process safety management systems required by relevant standards issued by the National Fire Protection Association (NFPA). Properly implemented, process safety management ensures the safe design, construction, and operation of hazardous facilities/activities, such as those processing combustible solids. Process safety management acts as guard against unforeseen events and prevents factors that might not otherwise have been considered from being the cause of catastrophic events.

For example, process hazard analysis (PHA) is one element of process safety management that seeks to identify how design deficiencies, equipment failures, or human errors could lead to catastrophic events, and then identifies protections that are required to prevent such catastrophic events. Properly conducted, a PHA would have prompted Sun to:

- Evaluate the design of the dust collection system. This would have considered what was entering the dust collection system from the mixers – including the potential for solvent vapor to accompany the dust. This would have identified key operating and design parameters necessary to avoid the unsafe accumulation of dust and liquids in the system ductwork.
- Consider the design of the Fike explosion suppression/isolation system and its integration into the overall design of the dust collection system. This would have identified factors required to be reflected in the custom Fike design to meet the unique needs of the Sun dust collection system. This would have provided perspective on the capabilities of the Fike system; e.g., that it provided protection against an event originating in the dust collector and prevented propagation of the event through the ductwork back to the mixers, but was not specified to prevent the propagation of an event originating within

the ductwork, outside of the dust collector. At Sun's request, Fike representatives could have participated in the PHA.

- Identify that tying the vacuum cleaning connections into the dust collection system was an imprudent consideration.

Management of Change (MOC) and Prestart-up Safety Review (PSSR), two other process safety management system elements, would have prompted SUN to identify that the new dust collection system was a radical change from the prior scrubber system. These elements would also have identified and provided confirmation that all requirements for the safe operation of the new dust collection system had been satisfied before the system was started up.

Collectively, the process safety management system elements described in the NFPA standards, but not implemented by Sun, would have prevented the October 9, 2012 incident.

Conclusions:

It is my conclusion that Sun failed to apply common-sense industry process safety management practices. Further, Sun failed to comply with relevant requirements set forth in industry consensus standards and its own company standards and procedures. A detailed discussion of the identified failures is provided in the balance of this report. These failures were part of an overall failure to properly engineer, which included the failure to follow necessary and required practices to properly integrate the customized explosion protection system equipment Sun had selected and ordered into the dust collection system Sun had designed and placed into operation.

It is my opinion that, within a reasonable degree of engineering certainty, had Sun implemented the practices and requirements detailed below, the October 9, 2012 event would not have occurred.

It is also my opinion that the failures described are not related to the selection of, or representations regarding, the Fike equipment sold to Sun. Rather they are failures of engineering and failures to properly implement the process safety management systems required to place these pieces of equipment properly into operation as part of the overall Dust Collection System designed by Sun.

My conclusions are based on presently known facts and information supplied and reviewed to date. A listing of the materials reviewed, which formed the basis of my opinions, is provided in Attachment B.

Analysis of requirements and identified implementation gaps:

1. In its Environmental, Health and Safety Policy[1], Sun Chemical and/or U.S. Ink establishes an express policy to "provide a safe and secure workplace and to benefit society by ensuring that [its] operations:

   - Meet all relevant laws, regulations and international agreements.
   - Are conducted safely, while protecting the health and security of all employees and other persons who may be affected by our actions."

   Furthermore, the Environmental, Health and Safety Policy states that "Sun Chemical will:

   - Conduct all activities responsibly, in accordance with this policy and Sun Chemical's SunCare® EHS management system.
   - Implement SunCare® at all Sun Chemical operations and conduct regular reviews to determine effectiveness.
   - Ensure that EHS policies and directives: Are implemented at all operational levels; rank among the highest corporate priorities; promote "best practices", maintain a commitment to continuous improvement.
   - Be open to EHS information and knowledge exchange among all SBUs and at all levels within the company, while ensuring this Policy is available to all interested internal and external parties.
   - Provide employees with EHS training and require them to exercise personal responsibility and cooperation to prevent harm to themselves, others and the environment.
   - Seek to design, develop and modify products and processed to prevent or minimize adverse effects on the environment and ensure people's health and safety."

   As the following analysis will demonstrate, Sun did not live up to the commitments it set forth in its corporate policy.

2. NFPA 654 provides industry-recognized and generally accepted requirements on the design, operation, and maintenance of facilities handling, generating, or processing combustible dusts such as were present in the Sun facility. The new dust collection system was designed and installed between about March 2011 and October 2012. Thus, the edition of NFPA 654 applicable during this timeframe

[1] Sun Chemical Environmental, Health and Safety Policy, July 11, 2011, SUN00033543

was the 2006 edition.[2] NFPA 654 references NFPA 91 for certain additional requirements. The applicable edition of NFPA 91 was the 2010 edition.[3]

3. The operations in the premix room fall within the scope of coverage for NFPA 654. NFPA 654 states specifically: [4]

> **1.1.1** This standard shall apply to all phases of the manufacturing, processing, blending, pneumatic conveying, repackaging, and handling of combustible particulate solids or hybrid mixtures, regardless of concentration or particle size, where the materials present a fire or explosion hazard.

4. The owner/operator of the facility (in this case, Sun) bears the responsibility for compliance with NFPA 654. NFPA 654 states specifically: [5]

> **1.1.2** The owner/operator shall be responsible for implementing the requirements in this standard.

5. The Purpose and Goal of NFPA 654 are: [6]

> **1.2 Purpose.** The purpose of this standard is to prescribe technical requirements for safety to life and property from fire and explosion and to minimize the resulting damage from a fire or explosion.
>
> **1.3 Goal.** The goal of this standard is to provide safety measures to prevent and mitigate fires and dust explosions in facilities that handle combustible particulate solids.

6. The 2010 New Jersey Administrative Code,[7] at §5:23-3.14(a)(1), adopted the 2009 International Building Code[8], which states:

> **[F] 415.6.1** Combustible dusts, grain processing and storage. The provisions of Sections 415.6.1.1 through 415.6.1.6 shall apply to buildings in which materials that produce combustible dusts are stored or handled. Buildings that store or handle combustible dusts shall comply with the applicable provisions of NFPA 61, NFPA 85, NFPA 120, NFPA 484, NFPA 654, NFPA 655 and NFPA 664, and the International Fire Code.

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[2] NFPA 654, *Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids*, 2006 Ed.
[3] NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids*, 2010 Ed.
[4] NFPA 654, 2006 Ed.
[5] *Ibid.*
[6] *Ibid.*
[7] *2010 New Jersey Administrative Code*
[8] International Code Council, *2009 International Building Code*

Thus, Sun had a legal responsibility to comply with NFPA 654 and other NFPA standards that NFPA 654 adopts by reference.

7. Sun was aware of NFPA 654 and its relevance to the design of the new dust collection system. This is demonstrated by the testimony, *inter alia*, of Scheer, Andrzejewski, and Blake.

   Scheer: "These – these materials would give me a good idea of NFPA 654, which is a very, very good thing to design a dust collector around. I actually took and got a copy of it, and I used to have it in my files."[9]

   Scheer: "…and I went to NFPA 654 and I read it cover to cover and highlighted and everything else to find out what we were getting into."[10]

   Andrzejewski: "Q: And you would expect whoever was formulating and designing this system for Sun Chemical would follow the dictates of NFPA 654, correct?
   …
   A. Correct."[11]

   Blake: "Q. Did you rely on any design standards during the design, any design approval process?
   A. Design standards relied on the NFPA recommendations and Factory Mutual data sheets.
   Q. That's NFPA 654?
   A. Right."[12]

8. NFPA 654 requires that the design of processes and facilities consider the physical and chemical properties that establish the hazardous characteristics of the materials being processed.[13] While NFPA 654 principally focuses on combustible dusts, it also addresses the hazards of hybrid mixtures. Hybrid mixtures are a combination of a flammable gas or vapor with a combustible dust, and can pose explosion hazards that are more severe than those associated with the dust alone. When communicating the characteristics of the process streams to the firm that was to design and provide the explosion protection system for the new dust collector, Sun did not consider the potential that the dirty air stream flowing from the mixers to the dust collector could include, in addition to combustible dusts, vapors evaporated from the solvents and oils added to the mixers. In his deposition, Richard Blake, the Sun representative who specified the material characteristics provided to the explosion protection system supplier, indicated an

[9] Scheer deposition, p. 245, lines 6 – 11.
[10] Scheer deposition, p. 312, lines 16 – 19.
[11] Andrzejewski deposition, p. 136, lines 15 – 20
[12] Blake deposition, p. 88, lines 17 – 23.
[13] NFPA 654, §4.1.1, 2006 Ed.

awareness of hybrid mixtures but could not confirm that such mixtures had been considered:

> "Q. At any point, did you take into account the facts that the combustible dust was mixed with the petroleum distillate vapors constituted a hybrid mixture?
>
> A. It may in abnormal situations. I do not recall.
>
> Q. So as you sit here today, you can't tell me if you did or you didn't take that into consideration?
>
> A. We discussed vapor pressure at the design temperature and I think Bob Scheer included that with, somewhere in here as a design temperature for the dust collector." [14]

Robert Scheer (referenced above) was the original design engineer and project manager for the duct collector project, including the explosion protection system. In his depo, he was asked about his awareness of hybrid mixtures:

> "Q. All right. But you never heard the phrase "hybrid mixture" used in conjunction with combustible dust and petroleum distillate vapors?
>
> A. I have never heard that term." [15]

As noted previously, Scheer had claimed "…I went to NFPA 654 and I read it cover to cover and highlighted and everything else to find out what we were getting into."[16]

The data ultimately provided by Blake, and forwarded to Suppression Systems Inc. (SSI), the explosion protection system designer and supplier, only addressed the hazardous characteristics of combustible dusts.[17] The proposal provided by Faber Industrial Technologies (Faber), the primary contractor for the duct collector project, indicated that the explosion protection system was designed based upon the data for dusts provided by Blake.[18]

Equipment suppliers must rely upon the basic data provided by customers for the design of systems. Available data indicate that SUN representatives did not address the potential significance of hybrid mixtures and that consideration of hybrid mixtures was not a factor in the design of the duct collector project, including the explosion protection system. In 2008, a prior fire in the mixer room resulted from overheating of a product batch due to prolonged agitation.[19] As the temperature of a combustible liquid increases, the concentration of vapor in the

[14] Blake deposition, p. 80, lines 3 – 15.
[15] Scheer deposition, p. 189, lines 8 – 12.
[16] Scheer deposition, p. 312, lines 16 – 19.
[17] Blake Exh. 10, UAS000310.
[18] Blake Exh. 7, SUN00003863
[19] Email from Paul A. Dudley to L. Lepore, March 5, 2008, SUN00014662 – 14664.

air above the liquid increases. For the 2008 fire to have occurred, a sufficient concentration of vapor had to be present at the top of the mix tank, where it would have entered the tank exhaust duct with the potential to form a hybrid mixture.

9. NFPA 654 requires that the design and its basis shall be documented and maintained for the life of the process. As noted previously, Scheer was the lead engineer for the duct collector project.[20] He was responsible for specifying, among other aspects of the design, the air flow rates within the branches of the dust collection system that served the various pieces of equipment connected to the system. Air flow rates and the associated consideration of duct diameters are important design factors, since an incorrect design could result in the accumulation of combustible dusts in the ductwork.

   Scheer retired from Sun at about the time that the design of the dust collection system was completed. Chris McCollum, who had been doing drafting work on the project, was subsequently assigned responsibility for following installation of the system, and for any check-out of the system prior to start-up.[21,22]

   In his deposition, Scheer indicates that the required flow rates, and any associated calculations, were not documented as part of the project records and, thus, were not available for McCollum's subsequent use:

   > "Q. Okay. So I think what I take from your answer is that you told him verbally what these criteria were before you left?
   >
   > A. Yeah.
   >
   > Q. You didn't write them down anywhere for him or hand them to him in any way and there's no calculation anywhere, correct?
   >
   > A. Probably -- probably not."[23]

   In his deposition testimony, McCollum could not affirm the availability of documented records of Scheer's calculations:

   > "Q. All right. You don't know what area he used as his basis for his calculation, do you?
   >
   > A. Not offhand.
   >
   > Q. Did you know then, is it written down anywhere?
   >
   > A. I don't know. It might have been."[24]

[20] Scheer deposition, p. 57, lines 23 – 24.
[21] Scheer deposition, p. 58, lines 2 – 3.
[22] Scheer deposition, p. 30, lines 14 – 21.
[23] Scheer deposition, p. 158, line 22 – p. 159, line 4.
[24] McCollum deposition, p. 128, lines 5 – 11.

Documentation of such information would have been an important factor in completing system checks prior to starting up the new dust collector system. As I show later, these important checks were never completed.

10. NFPA 654 requires that the design of the fire and explosion safety provisions for combustible dust facilities be based on a process hazard analysis (PHA) of the facility, the process, and the associated fire or explosion hazards.[25]

Sun's own company combustible dust safety procedure, SunCare Procedure HSE 065, also requires that a PHA be conducted for new projects involving combustible dust:

> **"7.1** If a dust is determined to be combustible by testing or extrapolation then a Process Hazard Analysis (PHA) is required to be performed on the system(s) where this dust is processed." [26]

HSE 065 also requires that the PHA consider "Dust accumulation in duct work".[27]

Richard Blake, a Sun Project Manager, recommended to DeMonte, Sheer, McCollum, Paul Dudley (in the Corporate Environmental, Health, and Safety Group) that a PHA be conducted:

> "The correct answer on all of these questions is to perform a hazard review with all the prescribed people together--sooner is better than later."[28]

In spite of Blake's recommendation and the clear requirements in NFPA 654 and SunCare Procedure HSE 065, Scott DeMonte, the plant engineering manager specified in an e-mail that a PHA need not be completed for the dust collector project, stating "In my review of the MOC and PHA forms pertaining to this project I do not see the need to have these documents completed."[29] This e-mail was directed to Blake, Scheer, Dudley. McCollum, and Rick Minner in Sun's corporate Environmental, Health, and Safety Group. DeMonte was asked about his decision in his deposition:

> "Q. What about PHA, what's that?
>
> A. Project hazard analysis.
>
> Q. Is there a form for that?
>
> A. I believe so.

[25] NFPA 654, §4.2.1, 2006 Ed.
[26] SunCare Procedure HSE 065, Combustible Dust, September· 12, 2011, SUN00004089
[27] *Ibid*., SUN00004090
[28] Email from Richard Blake to Scott DeMonte, 1/23/2012, SUN00001833.
[29] SUN00001881

> Q. Was there ever a project hazard analysis form completed regarding this dust collector project?
>
> A. No.
>
> Q. Why not?
>
> A. In my view, the project hazard analysis form was not required because it didn't meet the requirements."[30]

Consequently a PHA, which would have assessed the potential for accumulation in the dust collection system ducts and would have evaluated the need and adequacy of proposed protection measures, was never conducted for the dust collection project. This was one of several lost opportunities to prevent the October 9, 2012 event. Despite the fact that DeMonte's email was forwarded to Sun's engineering team and representatives of Sun's Corporate Environmental, Health, and Safety Group, no one objected to the decision to ignore policies, standards and the specific direction previously given by Blake.

There is no evidence that Sun's decision not to conduct a PHA (or MOC) was forwarded or shared with the dust collection manufacturer or Fike/SSI.

11. It is an industry practice to consider learnings from prior incident investigations when conducting a PHA. As noted previously, high temperature due to excessive agitation led to a fire in one mixer in 2008. [31] A fire in another mixer in 2006 resulted from an overheated bearing on the agitator, which ignited the contents of the mixer. [32] A PHA, had it been conducted, would have considered both of these incidents, applying relevant learnings to the consideration of the adequacy of the design of the new dust collection system.

    Sun's investigation of the 2008 fire led Sun's Environmental Health personnel to propose high temperature interlocks for the mixers.[33] These interlocks would have been designed to shut down a mixer if the mixer temperature approached an unsafe value. Sun requested a proposal from a vendor for installing these interlocks, but ultimately elected not to install them.[34] It appears that Sun may have determined that the cost of the interlocks was too expensive. In any case they were never purchased or utilized.

    Had the consideration for the need for high temperature interlocks been formalized as a recommendation in a PHA, standard industry practice would dictate that the recommendation be tracked to its resolution. A recommendation can be denied if further analysis shows that it is infeasible, if it is not needed to ensure safety, or if equivalent protection can be provided in a different manner. I

[30] DeMonte deposition, p. 166, lines 9 – 20.
[31] Email from Paul A. Dudley to L. Lepore, March 5, 2008, SUN00014662 – 14664.
[32] Email from Paul A. Dudley to L. Lepore, September 22, 2006, SUN00014448 – 14449.
[33] Email from Paul A. Dudley to L. Lepore, March 5, 2008, SUN00014662 – 14664.
[34] Eric Alter deposition, pp. 30 – 31.

have been provided no documentation showing the rationale or Sun's decision not to install the high temperature interlocks.

12. NFPA 654 requires that management-of-change (MOC) procedures be used to evaluate, *inter alia*, the safety and health implications of changes such as the replacement of the previous scrubber system with the new dust collection system.[35] NFPA 654 does not require implementation of the MOC procedure for a replacement-in-kind; i.e., a replacement that satisfies the design specifications for the original installation.[36]

    In an email to DeMonte, Chris Stenger (Sun's Corporate Environmental Manager) stated that the new dust collection system would not be a replacement-in-kind. [37] Nonetheless, DeMonte took the position that, since the dust collector was intended to remove dust from the facility and the scrubber that it was to replace had the same function, then the replacement was a replacement-in-kind.

    > "At the time my knowledge was that it was-- the engineering department were replacing a piece of equipment that had the same functionality. And my understanding of what that functionality was was [sic] replacement of like kind."[38]

    And,

    > "MR. DEMONTE: Well the functionality is that the goal was to capture fugitive dust. That's what the old performance of the dust collector, scrubber, did as well as the new one. So that's lye [sic] kind. We didn't take a new procedure like that but we wanted to capture fugitive dust. That's what the new dust collector did as well as the old dust collector."[39]

    However, other Sun employees offer the contrary opinion. Gary Andrzejewski (Sun's Corporate Vice President of Environmental Affairs) testified that:

    > "Q. Would this have been in Sun's estimation a like in kind exchange to exchange the scrubber as was done for the dust collector for the facility on Central Avenue where the incident happened on October 9, 2012?
    >
    > …
    >
    > A. No" [40]

    And, Brian Panczyk (DeMonte's supervisor) testified:

    > "Q. Okay. Was the dust collector system a like and kind change from the scrubber system at the Central Avenue facility?
    >
    > A. I would say no."[41]

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[35] NFPA 654, §4.3, 2006 Ed.
[36] Ibid., §4.3.1.2 and §3.3.20
[37] Email, Chris Stenger to DeMonte, 2/21/12, SUN00003817
[38] DeMonte deposition, p. 282.
[39] DeMonte CSB interview, p. 41.
[40] Gary Andrzejewski deposition, pp. 167 – 168.

Clearly, replacing a wet scrubber with a dry cartridge dust collector does not constitute a replacement-in-kind; i.e., the replacement does not satisfy the equipment design specifications for the original installation.

Sun's own company combustible dust safety procedure, HSE 065, also requires that an MOC be conducted for new projects involving combustible dust:

> "**7.5 Management of Change (MOC)**
>
> Changes to a system that handles combustible dust must be evaluated for risk before any changes are implemented."[42]

Furthermore, Sun's MOC procedure, HSE 193 states:

> **"2.0 SCOPE**
>
> This procedure applies to all Manufacturing Plants, and specific Locations identified by Corporate EHS and it is used to manage changes to process chemicals, technology, equipment, and procedures; and other changes that could affect process safety."[43]

In his deposition, Blake explains why an MOC is important:

> "Q. Why do you do it?
>
> A. So that the proper expertise is applied to any changes that they may not recognize as a hazard."[44]

And:

> Q. And the objective of it is what?
>
> A. To highlight changes and look for risks involved, risk in anything from others. MOC for OSHA covered facilities is, has one context. That's also being used in the industry for non-OSHA PSM covered areas in general."[45]

In spite of the clear requirements in NFPA 654 and SunCare Procedures HSE 065 and HSE 193, as noted above, DeMonte specified that an MOC need not be completed for the dust collector project. He stated "In my review of the MOC and PHA forms pertaining to this project I do not see the need to have these documents completed." [46]

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[41] Brian Panczyk deposition, pp 77-78.
[42] SunCare Procedure HSE 065, SUN00004091
[43] SunCare Procedure HSE 193, *Management of Change Procedure*, USICSB-E-00012468
[44] Blake deposition, p. 85, lines 10 – 13
[45] Ibid., p. 85, lines 18 – 24
[46] SUN00001881

When Sun elected to forgo MOC controls over the addition of the dust collection system, they abandoned an opportunity to convene a team of subject matter experts to identify the hazards of the new system and evaluate needed controls for those hazards. A formalized MOC would have identified any action items which would need to be completed before the new system was first operated.

13. The dust collection system constitutes a pneumatic conveying system, as addressed in NFPA 654. NFPA 654 requires that conveying systems that handle combustible particulate solids be designed by and installed under the supervision of qualified engineers who are knowledgeable about these systems and their associated hazards.[47] NFPA 654 also requires that ducts handling combustible particulate solids conform to the requirements of NFPA 91.[48] NFPA 91, in turn, requires that the design and installation of exhausts systems be the responsibility of persons having knowledge of these systems.[49]

    As previously established, the new dust collection system was designed by Scheer, who retired before it was installed. McCollum served as a draftsman, documenting Scheer's design and, after Scheer's retirement, provided liaison between Sun and the contractors installing the system. Only McCollum was available to coordinate any pre-startup inspections and tests of the new system. As DeMonte stated in his deposition:

    > "Q. … At the time that this incident occurred on October 9th 2012, the only engineer responsible for this project that was there to oversee the turn on of this dust collector was Chris McCollum?
    >
    > A. That's correct."[50]

    In his deposition, Scheer states that he had installed at least five dust collection systems in his career.

    Deposition testimony indicates that McCollum had no familiarity with NFPA 654 and no prior background with dust collection and exhaust systems. In his deposition, Scheer acknowledged that McCollum had no relevant prior experience with dust collection systems:

    > "Q. Was Chris McCollum in your estimation qualified to design a process system like this dust collector?
    >
    > A. I taught him a lot. He's never designed a dust collector system. I have. And basically, he was following me around for about six months on what I'm doing."[51]

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[47] NFPA 654, §4.4, 2006 Ed.
[48] Ibid., §7.6.1.
[49] NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids*, §4.1.1, 2010 Ed.
[50] DeMonte deposition, p. 43, lines 14 – 19

In his deposition, McCollum confirmed that he had no relevant prior experience with designing or installing dust collection systems prior to this project:

> "Q. Before you got involved in this particular project, had you ever designed a dust collector or a scrubber system for a room where there were dust particulates before?
>
> A. No.
>
> Q. Any involvement at all in a dust collection system before this particular one?
>
> A. No.
>
> Q. And were you ever responsible for overseeing the installation and implementation of a dust collector system before this one?
>
> A. No." [52]

Further, McCollum's deposition testimony indicates a profound unfamiliarity with NFPA 654 and its requirements:

> "Q. Did you yourself consult with NFPA 654 in relation to this diagram, McCollum-1?
>
> A. No, I -- Bob told me to draw something up, he told me what to draw, and I drew it." [53]

> "Q. All right. Are you required by any code of regulations to design the system in accordance with NFPA 654 or some other engineering standard?
>
> …
>
> THE WITNESS: I have no idea."[54]

> "Q. Well, is there some standard, other than NFPA 654, another written standard that Sun Chemical says if you're going it design a system, at minimum it has to meet this standard?
>
> A. I'm not sure what it is. They have some standard."[55]

> "Q. Okay. Do you know if NFPA 654 permits the use of flexible duct?
>
> A. I have no way of knowing that." [56]

Available evidence indicates that neither Scheer nor McCollum were adequately qualified for their respective roles in the design, installation, inspection, and

[51] Scheer deposition, p. 29, lines 11 – 17.
[52] McCollum deposition, p. 69, lines 11 – 22.
[53] Ibid., p. 126, lines 6 – 10
[54] Ibid., p. 126, lines 11 – 17
[55] Ibid., p. 126, line 23 – p. 127, line 4
[56] Ibid., p. 138, lines 21 – 23

startup of the combustible dust collection system. As such, they did not satisfy the qualification requirements of NFPA 654 and NFPA 91.

14. NFPA 654 and NFPA 91 contain engineering and operational requirements intended to ensure that combustible materials do not accumulate in ducts transporting such materials. The underlying concern is the potential for fires and explosions either inside the duct or external to the duct should the duct be breached, releasing its contents. Relevant requirements include, but are not limited to, appropriate ductwork sizing and correct operational sequencing in NFPA 654[57] and adequate fan capacity in NFPA 91.[58]

    A report of an investigation of this incident, conducted by an independent investigatory body, stated that "… inspections revealed large accumulations of black, burned, and unburned materials" in the dust collection system ductwork.[59] The accumulations of combustible dust observed in the ducts after the event indicate that the dust collection system, as designed, installed, and operated did not achieve the NFPA goal of avoiding accumulation of dust within the ductwork.

15. NFPA 91 requires that an exhaust system be inherently balanced, or a means be provided for balancing the system.[60] Balancing involves establishing that the air flow through the different branches of the system is properly distributed to ensure that the flow rate is sufficient for the system to operate as intended (in this case, to avoid accumulation of combustible solids in any duct). Deposition testimony indicates that the airflows in the new dust collection system were not balanced prior to placing the system in service, and that McCollum was not aware of what some of those velocities should be. (Recall that Scheer, in his deposition, indicated that the required flow rates for the system were not documented as part of the project records.) From McCollum's deposition:

    > Q. When the installation went in, did you verify it any way by going and testing for airflow velocity from any of the mixers?
    >
    > A. No. [61]

    > Q. … Do you know who it was that was to adjust the system to get the correct flow?
    >
    > A. That would have been Scott or myself.
    >
    > Q. Did you work to adjust the system to get the correct flow?
    >
    > A. Didn't have time.
    >
    > Q. So that never happened before the explosion happened?

---

[57] NFPA 654, §7.3.2.4 and §7.3.3, 2006 Ed.
[58] NFPA 91, §4.1.5, 2010 Ed.
[59] CSB, *US Ink/Sun Chemical Corporation, Ink Dust Explosion and Flash Fires in, East Rutherford, New Jersey*, No. 2013-01-I-NJ.
[60] NFPA 91, §4.4.1, 2010 Ed.
[61] McCollum deposition, p. 135, lines 11 – 14.

A. Correct. [62]

Q. Was there ever any discussion about letting the system run for a period of time while one mix at a time was run and adjustments were made in the flow to determine the flow was appropriate and then checking the ducts to make sure clumping wasn't occurring and then going back and adjusting the flow again?

…

THE WITNESS: I don't think so.[63]

Q. Do you know the capture velocity criteria used for the hood at the dump station?

A. Not offhand, no.[64]

In spite of McCollum's lack of experience with dust collection systems, his supervisor did not provide him guidance on the tasks necessary to prepare the system for operation. From DeMonte's deposition:

Q. Do you recall counseling Mr. McCollum in properly setting the flow and measuring the flow of suction at the appropriate points of the system for the dust collector?

A. No.[65]

Sun did not exercise the appropriate standard of care to ensure that the new dust collection system had been properly prepared for a safe start-up. Improper air flows contributed to the accumulation of combustible solids in the ductwork, leading to the incident.

16. NFPA 91 requires that:

- "Exhaust systems shall be tested, inspected, and maintained to ensure safe operating conditions."[66]
- "When installation of a new system is complete, the system shall be tested to demonstrate performance before acceptance by the user."[67]

The required testing should have been conducted as part of a pre-startup safety review (PSSR). Sun's MOC procedure, HSE 193, requires that a PSSR be conducted for a higher risk (Risk 3 and Risk 4) change prior to startup.[68]

[62] McCollum deposition, p. 244, lines 10 – 18.
[63] McCollum deposition, p. 246, lines 6 – 15.
[64] McCollum deposition, p. 128, lines 3 – 8
[65] DeMonte deposition, p. 83, lines 15 – 19
[66] NFPA 91, §10.2, 2010 Ed.
[67] *Ibid.*, §10.3.1.

The need for completion of a PSSR was recognized by Robert Blake. In an email to the Sun design team and members of Sun's Corporate Environmental, Health, and Safety Group, he stated: "I assume you will perform a PSSR--pre-start safety review with EHS persons." However, deposition testimony shows that a PSSR was never conducted for the new dust collection system. From McCollum's deposition:

> Q. Are you aware of any pre-start safety review that was done at any time prior to this system being turned on?
>
> A. No, I'm not aware of any.
>
> Q. Who would have been responsible to do a pre-start safety review after the system was installed and before it was turned on?
>
> A. It would probably have been Scott or myself.
>
> Q. You yourself are unaware of Scott ever doing it, correct?
>
> A. Correct.
>
> Q. You didn't do it?
>
> A. No.[69]

> Q. I'm not going to mark anything to ask you this, but the pre-start safety review, we agree that wasn't completed, right?
>
> …
>
> THE WITNESS: I don't – I didn't do it, and I don't know if Scott did.
>
> …
>
> THE WITNESS: I don't recall Scott ever mentioning to me anything about a pre-start safety review.
>
> Q. Do you believe Scott would have assumed that you would have assumed the responsibility to make sure there was a pre-start safety review?
>
> A. No; because that was a Sun Chemical thing. That was -- he would know. I wasn't Sun Chemical.
>
> …
>
> Q. -- you would expect that he would know that he would do it for Sun Chemical; it didn't fall to you in your responsibilities working for Premier?
>
> A. Right.
>
> Q. Is that fair to say?

---

[68] SunCare Procedure HSE 193, USICSB-E-00012472

[69] McCollum deposition, p. 157, lines 7 – 20.

> A. And the rules had changed. This was new stuff to me. I hadn't even heard of any of this stuff from the time I was working for Sun before this, so -- [70]

> Q. Did you conduct any sort of safety review prior to the dust collector being turned on?
>
> A. I don't recall any safety review.[71]

Even though McCollum testified that he had not done a PSSR and was unfamiliar with the requirements to do so, DeMonte believed that McCollum had done a simpler pre-start checklist. However, as DeMonte testified, McCollum never provided him a copy of the checklist.

> Q. So, as you sit here today, it's your belief that Mr. McCollum completed a pre-start safety review and a checklist?
>
> A. A pre-start safety checklist. Not the PSSR, not that the form that NAI uses. We have our own checklist.
>
> Q. Okay. So, when he recommended a PSSR, that's not something that you would have followed anyway?
>
> A. Not that particular form, no.
>
> …
>
> Q. What is encompassed within that checklist?
>
> A. The safety checklist encompasses the confirmation of equipment is correct, that it's operating conditions have been met in the course and scope of work, the parameters are being monitored, that people have been trained by appropriate the personnel and people are attending for the training, people sign off on the training, and then functionality of the equipment as it's running, and then handling that ownership of that equipment over to the plant personnel, plant manager.
>
> Q. Have you ever seen that checklist?
>
> A. No.
>
> Q. Did you ever ask Mr. McCollum after the date of this incident to show you the checklist?
>
> A. I asked him to retrieve the checklist to bring back to the office.
>
> Q. Did you ever see it?
>
> A. No. [72]

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[70] McCollum deposition, p. 166, line 19 – p. 168, line 23
[71] McCollum deposition, p. 208, lines 2 – 5
[72] DeMonte deposition, p. 151, lines 19 – p. 168, line 7 – 16 and p. 152, line 17 – p. 153, line 13.

A properly conducted PSSR would seek to confirm that: the new equipment has been installed per the design; appropriate tests and inspections have been conducted; operating, maintenance, and emergency response procedures have been updated; and required training has been conducted. By forgoing the PSSR, Sun lost an opportunity to ensure that all required preparations for a safe startup of the new collection had been completed.

17. NFPA 91 requires that "Ductwork shall be examined periodically to determine adequacy of cleaning frequency." [73] The new dust collection system was not inspected after initial operation to confirm satisfactory performance and to verify that combustible dust was not collecting in the ductwork. Furthermore, there is no testimony that indicates that a periodic inspection frequency had been established to monitor for dust accumulations in the duct. From McCollum's deposition:

> Q. Was there any effort made by anyone to determine if when the new dust collector went on line after midnight on Tuesday up until the time of the explosion to determine whether the mix of oil, carbon black and gilsonite and the setting of the dust collector was leading to an accumulation of dust on the inside walls of the ducts?
>
> A. No.[74]

> Q. Was there ever any discussion about letting the system run for a period of time while one mix at a time was run and adjustments were made in the flow to determine the flow was appropriate and then checking the ducts to make sure clumping wasn't occurring and then going back and adjusting the flow again?
>
> …
>
> THE WITNESS: I don't think so.[75]

18. NFPA 654 requires that the facility, combustible particulate processes, and human element programs be designed, constructed, equipped, and maintained to protect occupants not in the immediate proximity of the ignition from the effects of fire, deflagration, and explosion for the time needed to evacuate, relocate, or take refuge.[76] The fact that so many personnel exposed themselves to injury by congregating in or near the pre-mix room, with a known fire in the room, indicates that, at a minimum, the training program and the emergency response program (both aspects of the human element programs) were not adequate to protect facility personnel.

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[73] NFPA 91, §10.5, 2010 Ed.
[74] McCollum deposition, p. 213, line 21 – P. 214, line 4
[75] McCollum deposition, p. 246, lines 6 – 15.
[76] NFPA 654, §4.5.1.1, 2006 Ed.

A review of the site emergency response plan revealed no relevant guidance for responding to fires in process areas.[77]

19. NFPA 654 requires that personnel be trained to use portable fire extinguishers in a manner that minimizes the generation of dust clouds during discharge.[78] The high velocity discharge from certain types of fire extinguishers, when directed at a pile of smoldering or burning combustible dust, can result in the suspension of the dust, creating of a combustible dust cloud. This can result in a flash fire or explosion, exposing personnel to the potential for serious injury.

    A fire extinguisher training presentation provided by Sun does not address the unique consideration related to fighting combustible dust fires.[79] In fact, it instructs the fire extinguisher user to "Aim at the base of the fire ... Hit the fuel."[80] This is precisely the wrong instructions to provide personnel fighting combustible dust fires.

20. NFPA 654 restricts the manifolding (interconnection) of dust collection ducts.[81]

    > **7.13.1.4.1** Manifolding of dust collection ducts to air–material separators shall not be permitted.
    >
    > **7.13.1.4.2** Dust collection ducts from a single piece of equipment or from multiple pieces of equipment interconnected on the same process stream shall be permitted to be manifolded.

    §7.13.1.4.2 is an exception to the more general prohibition of manifolding in §7.13.1.4.1 (the two requirements are expressed and linked in a fashion required by the NFPA Manual of Style). The dust collection system, as designed, manifolded the dust extraction lines from three separate mixers into the inlet line to the dust collector. Since each of the three mixers ran independently of the other two, a reasonable argument could be made that they did not constitute "equipment interconnected on the same process stream." In any event, tying the three vacuum cleaner pickup lines into the dust collection system clearly would not be allowed by §7.13.1.4.2 in NFPA 654.

21. NFPA 654 prohibits the return of floor sweepings to any machine.[82] The concern is that foreign objects (bolts, stones, etc.) in the floor sweepings could cause sparks or frictional heating inside of process equipment, leading to the ignition of a combustible dust cloud. The three vacuum pick-ups were connected to the duct leading to the new dust collector and the system design provided for the return of dust from the collector back to mixing tank T106. This provided a pathway for

[77] SunCare Procedure HSE 070, Emergency Contingency Plan, USICSB-E-00007853 – 00007881
[78] NFPA 654, §10.3.2, 2006 Ed.
[79] USICSB-E-00008009 - 00008038
[80] USICSB-E-00008031
[81] NFPA 654, §7.13.1.4.1 and §7.13.1.4.2, 2006 Ed.
[82] NFPA 654, §9.1.1.2, 2006 Ed.

returning material swept off of the pre-mix room floor and other surfaces back to process equipment, in violation of the NFPA 654 prohibition.

22. NFPA 654 requires that regular cleaning frequencies be established for walls, floors, and horizontal surfaces (such as equipment, ducts, pipes, hoods, ledges, beams, and above suspended ceilings and other concealed surfaces) to minimize dust accumulations within operating areas of the facility.[83] The concern is that combustible dust accumulations in processing areas pose the potential for dusts fires and, if the dust is suspended into the air, the potential for a dust cloud explosion.

    Paul Dudley, of the Corporate EHS Group, acknowledged that dust accumulation in the premix room had been a continuing problem:

    > "Since 2006 there have been 3 fires in the Premixer room. In all cases accumulation of free carbon black on equipment and structure of the Premixer room was cited as an unacceptable condition that requires attention as the carbon black provides a fuel source that only serves to propagate the fire events and potentially communicate the fire event to additional portions of the facility."[84]

    While deposition testimony indicates that housekeeping was conducted from time to time to remove dust from the pre-mix room, there is no testimony indicating that regular cleaning frequencies were established or that the housekeeping that was conducted was sufficient to meet the performance goals established by the NFPA 654 requirement.

23. Dudley's email established that the release of dust from the process equipment into the pre-mix room was a direct consequence of the performance inadequacies of the prior filter/scrubber.[85] However, Sun continued to operate the pre-mix room with the deficient scrubber/filter and, even without the scrubber/filter after it had been removed to allow installation of the new dust collection system. From McCollum's deposition:

    > "Q. It's true, however, that before the dust collector goes online and after the scrubber is taken out of the room, that there they're still running three shifts a day running black ink in there, right?
    >
    > A. Correct.
    >
    > Q. So it never stopped putting dust into the air even when there's nothing taken out, correct?

[83] NFPA 654, §8.2.1.2, 2006 Ed.
[84] Email, Dudley to Scheer, April 27, 2011, SUN00003834
[85] *Ibid.*

A. Correct."[86]

This allowed the continued accumulation of combustible dust within the pre-mix room.

24. Under some circumstances, electrical equipment can ignite combustible dusts, causing fires or explosions. For this reason, special considerations can be required for the design, installation, and maintenance of electrical equipment. NFPA 654 requires:

> **"6.6.2** In local areas of a plant where a hazardous quantity of dust accumulates or is suspended in air, the area shall be classified and all electrical equipment and installations in those local areas shall comply with Article 502 or Article 503 of NFPA 70, National Electrical Code, as applicable."[87]

Areas where specialized electrical equipment is not required are termed unclassified areas. NFPA 654 recommends that an area can remain unclassified provided that: (1) dust accumulations on surfaces are no more than 1/8 inch thick; (2) such accumulations only occur infrequently; and (3) they must be cleaned up during the same shift.[88] Various deposition testimony provided ample basis for concluding that these three criteria were consistently not satisfied. This is reinforced by Dudley's email in which he states that the dust accumulation is "… unacceptable as the room, by design is a [sic] unclassified area, and electric devices and nearby switch gear would likely be NEMA 1 and subject to internal contamination. This is a serious safety hazard since carbon black is conductive."[89]

Migration of conductive dusts, such as carbon black, into electrical equipment can produce sparking due to short circuiting that could ignite the dust. Sun's housekeeping practices were not sufficient to satisfy the electrical classification requirements in NFPA 70 and NFPA 654, and posed the serious potential that electrical equipment in the pre-mix room could ignite combustible dust fires or explosions.

25. On December 17, 2010, a fire occurred in an exhaust air duct at Sun's Muskegon, MI facility. The investigation report for this event reveals many parallels with October 9, 2012 fire at Sun's East Rutherford, facility. These include:[90]

- Engineering inadequacies resulted in unbalanced air flows through an exhaust system, leading to the accumulation of process materials solids in the ducts, which caused the fire.

[86] McCollum deposition, p. 271, lines 10 – 19.
[87] NFPA 654, §6.6.2, 2006 Ed.
[88] NFPA 654, Table A.6.6.2, 2006 Ed.
[89] Email, Dudley to Scheer, April 27, 2011, SUN00003834
[90] SunCare Incident Investigation Report, January 17, 2011

- System changes were made without a proper MOC to evaluate the significance of the changes.
- The importance of a thorough PHA was demonstrated (while a PHA had been conducted, it was not sufficiently rigorous to identify the scenario that ultimately led to the fire).

Learnings from the prior event should have prompted SUN to exercise greater due diligence with East Rutherford dust collection system project.

Summary:

Process Safety Management is not optional but is a necessary part of the design and implementation of manufacturing processes handling hazardous materials, such as the combustible solids handled at Sun. Process Safety Management is implemented to increase safety by preventing potentially catastrophic events. In short, Process Safety Management is a guard against catastrophe.

A dust collection system includes the dust collector and the ductwork connecting it to the equipment it serves (in Sun's case, the mixers and the bag dumping station). As is often the case, Sun's dust collection system included an explosion suppression system to protect the duct collector from a deflagration arising from within it. The design of the explosion suppression system is particular to the parameters of the dust collector and the materials that it collects. The successful integration of the explosion suppression system with the balance of the dust collection system needed Sun to utilize the principles of process safety management set forth in this report. That did not occur.

Sun had an awareness of combustible dust hazards and an awareness of NFPA 654. However, this awareness did not stimulate the proper consideration and implementation of the protections and controls specified in both the NFPA documents and Sun's own standards and procedures. The evidence related to the implementation of the dust collection system placed into operation in October of 2012 indicates that, in fact, Sun was consistently ignoring its own written standards and procedures as well as the relevant industry standards.

My overarching conclusions, founded on the above, are 1) that the October 9, 2012 incident would not have occurred had Sun complied with the requirements of NFPA 654 and NFPA 91 and 2) that, considering the many non-conformances with the requirements of NFPA 654 and NFPA 91 that were associated with the design and operation of the new dust collection system, there was a virtual certainty that a serious combustible dust event would have occurred within the pre-mix room at some point in time.

W. L. Frank, P.E.

Attachment A
Curriculum Vitae
Walter L. Frank, Jr., P.E.

WALTER L. FRANK, P.E. (Delaware)
Process Risk Consultant
President, Frank Risk Solutions, Inc.
Wilmington, Delaware

EDUCATION

Rose-Hulman Institute of Technology, Terre Haute, Indiana – B.S. Chem. Eng., with honors, 1973

PROFESSIONAL REGISTRATION

Delaware: Professional Engineer (License #6247, issued 1982)

SUMMARY OF EXPERIENCE

Mr. Frank is President and Principal Consultant for Frank Risk Solutions, Inc. He provides support to industry in the areas of process hazard analysis (PHA); consequence assessment; quantitative risk assessment; incident investigation; explosion hazard evaluation and control; chemical reactivity hazard management; the development, auditing, and improvement of process safety management (PSM) systems; litigation support; regulatory compliance; safety culture evaluation; and enhancing organizational effectiveness in support of process safety performance. He was the principal or contributing author for six books on process safety related topics.

Mr. Frank has over 43 years' experience in the chemical process industries, having held assignments in the areas of plant technical support, manufacturing supervision, research and development, design, construction review and project start-up, and safety consulting. Before founding Frank Risk Solutions, Inc. in 2007, he spent 10 years with ABS Consulting (formerly EQE International) and 24 years with DuPont (including 10 years in the Process Safety & Fire Protection Group of the DuPont Engineering Department).

2007 – Present President, Frank Risk Solutions, Inc. – Wilmington, Delaware

Recent projects include: ◆ Conducting two series of assessments of corporate process safety capability, management system structure, and organizational/management effectiveness for the downstream & chemicals segment of a major international oil company ◆ Conducting a similar assessment for a large international petrochemical company ◆ Multiple PSM capability assessments at upstream facilities for a major international oil company ◆ Providing technical support to the Independent Expert monitoring, for the BP Board of Directors, the implementation of the recommendations contained in the BP U.S. Refineries Independent Safety Review Panel (Baker Panel) report ◆ Multiple PSM program assessments of refineries conducted under the auspices of the American Petroleum Institute (API) ◆ Numerous PSM program compliance audits, including leading a team conducting an audit for a 500,000 BPD refinery ◆ Serving as the third-party dust explosion expert for a confidential client implementing a combustible dust housekeeping program under a consent agreement ◆ Authoring a book providing guidance on the formulation of corporate risk tolerance criteria (project manager and principal author) ◆ Conducting a series of PSM gap analyses for a refiner seeking to apply PSM to marketing terminals, pipelines, and barge shipping ◆ Conducting combustible dust explosion hazards evaluations for various

clients in the paper, wood products, aircraft, textile-related, food, pharmaceutical, recycling, and silicon industries ◆ Providing technical expert witness support on six lawsuits ◆ Instructor for the AIChE Process Safety Boot Camp course, and other various continuing education courses on process safety culture, explosion hazard evaluation and control, combustible dust safety and explosion prevention, and promulgation of risk tolerance criteria ◆ Assisting an energy industry client develop a corporate risk standard ◆ Co-authoring the National Fire Protection Association's handbook *Guide to Combustible Dusts* ◆ Developing corporate standards on explosion venting and combustible dust safety for a pharmaceutical industry client.

1997 – 2007 Senior Consultant, ABS Consulting – Wilmington, Delaware

Projects included: ◆ Providing technical support to the BP Independent Safety Review Panel, including leading the evaluation teams for two refinery audits ◆ Assisting a multinational paper products company develop a safety culture evaluation protocol and piloting its use at a paper mill ◆ Developing an organizational effectiveness/safety culture evaluation tool for a confidential client ◆ Participating in an evaluation requested by the new owners of a refinery to determine the safety culture in effect at the new acquisition ◆ Serving as project manager and/or audit team member for over 50 PSM audits and program evaluations ◆ Assisting a multinational petroleum exploration/refining company develop corporate risk tolerance criteria ◆ Helping develop and conduct two annual safety workshops addressing safety culture issues for a major petroleum exploration and refining company ◆ Participating in a comprehensive review of the PSM and loss management systems for a major Canadian petroleum producer ◆ Developing and teaching continuing education courses on the topics of Understanding and Preventing Explosions, Understanding and Preventing Combustible Dust Explosions, and Strengthening Company and Facility Safety Culture ◆ Providing technical expert litigation support on three lawsuits involving explosions ◆ Helping develop chemical reactivity hazard management programs for a major paper manufacturer and a large pharmaceutical manufacturer ◆ Preparing a safety alert for the EPA addressing the use of excess flow valves in hazardous chemical service ◆ Assisting the US Chemical Safety and Hazard Investigation Board (CSB) in their evaluation of reactive chemical hazards issues, including providing expert testimony before the Board at a public hearing ◆ Assisting the CSB in their investigation of a major multi-fatality dust explosion ◆ Providing expert testimony before the CSB at a public hearing addressing the hazards of combustible dusts in industry ◆ Serving as auditor and project manager for two third-party audits mandated by a state regulatory agency under legal settlement agreements, including providing oversight of a follow-up three-year mechanical integrity program enhancement effort ◆ Serving as project manager and principal consultant responsible for preparing a risk review of operations at five ammonia and fertilizer manufacturing plants ◆ Assisting in the review of siting options for a new bulk liquid chlorine receipt and storage facility for a major fiber optic cable manufacturer ◆ Developing EPA RMP compliance programs and filings for several clients ◆ Facilitating four site security analyses ◆ Conducting numerous other incident investigations, PHAs, and consequence/risk assessments for the defense, food, pharmaceutical, chemical and petroleum industries.

1987 – 1997 Consultant, DuPont – Wilmington, Delaware

Responsibilities included providing consulting support to both plant sites and corporate engineering design groups in the application of hazard assessment, consequence

assessment, quantitative risk assessment, and the implementation of PSM systems, specializing in explosion hazards evaluation and control. Consulting included: ◆ Conducting site audits for adherence to industry best practices ◆ Facilitating PHAs ◆ Evaluating of electrostatic ignition hazards ◆ Providing guidance on the application of explosion prevention technologies (e.g., the sizing of deflagration pressure relief panels) ◆ Modeling vapor cloud and other explosion scenarios ◆ Conducting facility siting evaluations ◆ Evaluating chemical reactivity and combustion hazards ◆ Writing DuPont's corporate facility siting standard (principal author) ◆ Providing technical support for three major facility evaluations ◆ Assisting approximately 20 industrial fire or explosion investigations, including three major explosions involving combustible dusts ◆ Providing technical support for a significant upgrade to the fire and explosion modeling module of the Trace® consequence modeling software package.

1973 – 1987 DuPont – Aiken, South Carolina.

Held various assignments involving: plant technical support, manufacturing supervision, oversight of mechanical integrity programs, design, research and development, incident investigation, training, construction review, operating procedure development, project startup, and process safety.

INDUSTRY INITIATIVES

Mr. Frank is an active participant in a variety of industry activities related to the creation and application of sound process safety technologies and systems. His efforts in helping industry trade groups and technical societies develop standards, best practices, and other forms of process safety guidance have included:

American Institute of Chemical Engineers, Center for Chemical Process Safety (CCPS) - Assisted in the creation of a number of books in the CCPS Guidelines series, including:

- *Guidelines for Hazard Evaluation Procedures*, 2nd Edition
- *Guidelines for Process Safety Documentation* (chaired editorial committee)
- *Guidelines for Process Safety in Outsourced Manufacturing Operations*
- *Guidelines for Evaluating Process Plant Buildings for External Explosions and Fires*
- *Estimating the Flammable Mass of a Vapor Cloud*
- *Guidelines for Evaluating the Characteristics of Vapor Cloud Explosions, Flash Fires, and BLEVEs* (the updated edition)
- *Guidelines for Process Safety in Batch Reaction Systems* (chaired editorial committee)
- *Understanding Explosions*
- *Revalidating Process Hazard Analyses* (principal author)
- *Guidelines for Safe Handling of Hazardous Particulate Solids*
- *Essential Practices for Managing Reactive Chemicals Hazards*
- *Guidelines for Safe Design and Operation of Process Vent and Emissions Control Systems*
- *Guidelines for Risk Based Process Safety* (co-author)
- *Guidelines for Management of Change Systems* (co-author)
- *Safety Culture Awareness Tool* (project manager)
- *Guidelines for Developing Quantitative Safety Risk Criteria* (project manager and lead author)
- *A Risk Based Approach to Assessing, Controlling, and Mitigating Dust Fire and Explosion Hazards* (CCPS Staff Consultant, in progress)
- *Essential Practices for Safety Culture* (in progress)

American Petroleum Institute (API)

- Served on subcommittee that developed analytical guidance for addressing facility siting. Assisted in the development of API Recommended Practice 752, *Management of Hazards Associated with Location of Process Plant Buildings*.
- Chaired a joint API/Chemical Manufacturers Association task force chartered to prepare a white paper evaluating the technical opportunities and obstacles to broadening OSHA's regulation of reactive chemicals.
- Currently an assessor for the API Process Safety Assessment Program.

Delaware Department of Natural Resources and Environmental Control - Provided industry input for the technical bases for the regulation of toxic, reactive, and flammable materials within the state of Delaware.

Organization Resources Counselors (ORC) and Chemical Manufacturers Association (CMA, now American Chemistry Council) - Helped develop industry's response to federal process safety regulatory initiatives. Assisted in the development of technical bases for ORC's and CMA's recommendations to both OSHA and EPA during the respective process safety regulation rulemaking processes.

American Chemistry Council – Helped prepare and conduct three workshops training nearly 300 attendees in the conduct of site security vulnerability analyses to assess and mitigate the risk of terrorist attack.

US Chemical Safety and Hazard Investigation Board (CSB) – Provided technical support to the CSB's investigation of reactive chemical hazards, including peer review of the draft report, and providing expert testimony at a public hearing. Provided expert technical support to the investigation of a multi-fatality dust explosion that occurred in a rubber formulation process, including peer review of the draft report.

National Fire Protection Association (NFPA) – Member (since 7/94) and immediate past-Chairman (1/03 to 8/13) of the Technical Committee on Handling and Conveying of Dusts, Vapors, and Gases. Assisted in multiple revisions of:

- NFPA 654, *Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids*
- NFPA 650, *Standard for Pneumatic Conveying Systems for Handling Combustible Particulate Solids* (now integrated into NFPA 654)
- NFPA 655, *Standard for Prevention of Sulfur Fires and Explosions*
- NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids*

Member of NFPA Technical Committee on Fundamentals of Combustible Dusts (since 2011) and a member of the NFPA Combustible Dusts Technical Correlating Committee that oversees the various NFPA combustible dust standards (since 2011). Assisted in the development of:

- NFPA 652, *Standard on Combustible Dusts*

Helped develop and previously instructed NFPA's 2-day course on evaluating and controlling combustible dust explosion hazards.

NFPA Fire Protection Research Foundation − Member of organizing committee for 2009, 2010, and 2011 Combustible Dust Symposia.

American Institute of Chemical Engineers – Served in various volunteer roles, including:

- Formerly a Director and Chair of the Safety and Health Division
- Member and past Chair of the Group 11a committee, which organizes the Annual Loss Prevention Symposium (LPS)
- Former member of the Group 11b committee, which organizes the Annual Process Plant Safety Symposium
- Formerly a member of Governmental Relations Committee
- Member of the Editorial Board for *Process Safety Progress*, the quarterly technical journal published by the Safety and Health Division
- Chaired numerous technical sessions and workshops at various AIChE symposia
- Chairman of the 2005, and Vice-Chair of the 2004 LPS

Center for Chemical Process Safety – Served in various volunteer and staff roles, including:

- Batch Process Safety Subcommittee, Chair
- Process Safety Documentation Subcommittee, Chair
- Vapor Cloud Explosion Subcommittee, Member
- Project Planning Subcommittee, Past Member
- Outsourced Manufacturing Subcommittee, Member
- Organizing Committee, 2003 CCPS Annual Workshop and Symposium, Member
- Chemical Reactivity Roundtable, Member
- Safety Culture Focus Group, Member
- Vision 20/20 project committee, Member
- Currently CCPS Staff Consultant with responsibility for the combustible dust safety Guidelines project.
- CCPS Certified Process Safety Professional (CCPSP) Credentialing Committee
- CCPS Process Safety Boot Camp instructor
  (Note: Some of the above committees have sun-setted.)

Organisation For Economic Cooperation And Development (OECD) – Member of the group of experts who provided input to the updating of OECD's guidance on developing safety performance indicators related to chemical accident prevention, preparedness, and response. Two separate publications were developed – one for industry (Series on Chemical Accidents, Publ. No. 19) and one for public authorities, communities, and the public (Series on Chemical Accidents, Publ. No. 18).

Delaware Association of Professional Engineers (DE State PE licensing board)

- Licensed professional engineer, chemical engineering (license number 6247)
- Elected Member of Council, Chemical Engineering Seat (1997 – 2005)
- Law Enforcement and Ethics Committee, Former Member and Past Chair
- Examining Committee, Former Member
- Law Revision Committee, Former Co-chair

PROFESSIONAL AFFILIATIONS

American Institute of Chemical Engineers, Safety & Health Division Member
Center for Chemical Process Safety, Emeritus Member,
National Fire Protection Association
Delaware Association of Professional Engineers
Canadian Society for Chemical Engineering

AWARDS AND ACKNOWLEDGMENTS

Fellow, American Institute of Chemical Engineers
Fellow, Center for Chemical Process Safety
Certificate of Distinguished Service, Delaware Association of Professional Engineers
Committee Service Award, National Fire Protection Association
Exemplary Service Award, AIChE Safety and Health Division

PUBLICATIONS AND PRESENTATIONS

"The Technical Basis for Regulation of Toxic and Explosive Substances in Delaware," presented at the 1990 Spring National Meeting of the American Institute of Chemical Engineers.

"Hazard Reviews of Processes and Equipment," presented at the Delaware State Chamber of Commerce Extremely Hazardous Substances Seminar, May 1990.

"The Process Safety Impact of Distributed Control Systems," with O. M. Zodeh, presented at the 1990 Loss Prevention Symposium (LPS) of the AIChE, at the Texas Chemical Council 1991 Safety Seminar and at the CMA 1992 Process Control Users Forum. Published in *Plant/Operations Progress*, Vol. 10, No. 2, April 1991.

"A Survey of Hazard Evaluation Techniques," with J. S. Arendt and J. E. Giffin, *Chemical Process Safety Report*, The Thompson Publishing Group, 1992.

"Developing a Risk Management Plan Under the New Clean Air Act Amendments," with P. R. Jann and E. D. Chikhliwala, presented at the 9th World Clean Air Congress, September 1992.

"Managing Change - A Multifaceted Approach," with A. F. Burk, presented at the 1992 Process Plant Safety Symposium (PPSS), AIChE South Texas Section.

"Technical Bases for Using Substance Lists and Threshold Quantities for Prioritizing Major Accident Prevention and Regulatory Activities," presented at the 1993 AIChE LPS, March 1993.

"Team Makeup...An Essential Element of a Successful Process Hazard Analysis," with J. E. Giffin and D. C. Hendershot, presented at the International Process Safety Management Conference and Workshop, San Francisco, CA, September 1993.

"CCPS Guidelines for Process Safety Documentation," with R. E. Witter, presented at the 1994 PPSS, AIChE South Texas Section.

"Evaluation of a Containment Building for a Liquid Chlorine Unloading Facility," presented at the 1995 AIChE LPS, August 1995.

“The Design and Use of Barricades - An Overview,” with E. Perez and J. Yeung, presented at the Second International Plant Operations and Design Conference, March 1997. *Chemical Engineering Progress*, October 1998.

“Using a Risk-Based Approach for Addressing Facility Siting Issues,” with D. W. Jones, presented at the 1998 AIChE LPS, March 1998. Published in *Chemical Engineering Progress*, May 1999.

"What Are Process Safety Management Audits Telling Operators?" with D. W. Jones and D. H. Hobbs, *Hydrocarbon Processing*, October 2000.

"Prospects for Future Process Safety-Related Regulations," with J. S. Arendt, presented at the 2001 AIChE PPSS, April 2001.

"Reshaping Process Safety Regulations," with J. S. Arendt, published in *Chemical Engineering Progress*, March 2002.

"Dust – The Other Explosion Hazard," presented at the 2003 CCPS Annual Workshop and Symposium, September 23-25, 2003, Scottsdale, Arizona. Updated and published as "Dust Explosion Prevention and the Critical Importance of Housekeeping" in Process Safety Progress, September 2004.

"Failures of Excess Flow Valves in Highly Hazardous Materials Service, "A Hazard Alert published by the US Environmental Protection Agency.

"Inerting for Explosion Prevention," presented at the 2004 AIChE LPS, April 2004.

"Sustaining a Sound Safety Culture," presentation made at the CITGO Petroleum Corporation, 2004 Safety Summit, July 2004.

"Essential Elements of a Sound Safety Culture," presented at the PPSS, AICHE Spring Meeting, April 2005.

American Institute of Chemical Engineers, 39th Annual LPS Proceedings, editor, 2005.

CCPS *Revalidating Process Hazard Analyses* (principal author)

CCPS *Guidelines for Risk-based Process Safety*, contributing author

CCPS *Guidelines for Management of Change*, contributing author

CCPS *Safety Culture Awareness Tool*, project manager and contributing author

CCPS *Guidelines for Developing Quantitative Safety Risk Criteria* (project manager and lead author)

"Safety Culture in the CCPS Risk-based Process Safety Model," presented at the PPSS, AICHE Spring Meeting, April 2006. Published in *Process Safety Progress,* September 2007.

"Connecting Process Safety Performance to Organizational Culture - A Root Cause Approach," with J. S. Arendt, presented at the PPSS, AICHE Spring Meeting, April 2007.

"NFPA 654 and Its Guidance for Dust Explosion Prevention," presented at the Texas Chemical Council/ACIT Environmental, Health and Safety Seminar, Galveston, Texas, June 2007.

Perry's Chemical Engineer's Handbook, 8th ed., contributor to Chapter 26, "Process Safety"

"Why Vapor Cloud Explosions Are Unlikely In Liquid Fuel Tank Farms," Presentation at the American Petroleum Institute for the Department of Homeland Security, March 2008.

"Choosing Appropriate Quantitative Safety Risk Criteria - Applications from the New CCPS Guidelines," with Dave Jones, Chevron Energy Technology Company, 24th Annual CCPS International Conference, Tampa, May 2009. Published in *Process Safety Progress,* Volume 29, Issue 4, December 2010.

"Housekeeping Solutions," with Mark L. Holcomb, Kimberly-Clark Corporation, NFPA Fire Protection Research Foundation, Combustible Dust Symposium, Baltimore, May 14, 2009.

"Challenges in Developing and Implementing Safety Risk Tolerance Criteria," Presented at the 44th Annual AIChE Loss Prevention Symposium, San Antonio, Texas, March 2010. Published in *Process Safety Progress*, Volume 30, Issue 3, September 2011.

"NFPA Dust Explosion Prevention Standards − Current and Prospective," Presented at the ORC Worldwide® Joint Meeting of the Occupational Safety and Health Group and the Corporate Health Directors Network, Washington, DC, August 2010.

"Process Hazard Analysis Fundamentals" [for combustible dust processes/facilities], Presented at the NFPA Fire Protection Research Foundation 2010 Symposium on Dust Explosion Hazard Recognition and Control: New Strategies, Kansas City, MO, October 2010. Repeated at the 2011 Dust Explosion Hazards Symposium, Detroit, MI, September 20-21, 2011.

NFPA® *Guide to Combustible Dusts*, 2012 (Co-author)

"On-Going Developments In Addressing Combustible Dust Hazards," Presented at the 9th Global Congress on Process Safety, San Antonio, Texas, 2013. Published in *Process Safety Progress*, Volume 34, Issue 1, March 2015.

Attachment B
Materials Reviewed

- 2010 New Jersey Administrative Code
- Andrzejewski deposition
- Andrzejewski interview with CSB
- Blake deposition
- Blake Exhibits 1 through 18
- Brian Panczyk deposition
- DeMonte deposition
- DeMonte Exhibit 9
- DeMonte interview with CSB
- Dudley deposition
- Email from Chris Stenger to DeMonte, 2/21/12, SUN00003817
- Email from Dudley to Scheer, April 27, 2011, SUN00003834
- Email from Paul A. Dudley to L. Lepore, March 5, 2008, SUN00014662 – 14664
- Email from Paul A. Dudley to L. Lepore, September 22, 2006, SUN00014448 – 14449
- Email from Richard Blake to Scott DeMonte, 1/23/2012, SUN00001833.
- Eric Alter deposition
- Gary Andrzejewski deposition
- International Code Council, 2009 International Building Code
- McCollum deposition
- McCollum interview with CSB
- Murphy Expert Report
- Myers Expert Report
- NFPA 654, *Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids*, 2006 Ed.
- NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids*, 2010 Ed.
- Panczyk deposition
- Scheer deposition
- Scheer interview with CSB
- Stenger CSB interview
- SUN00001881
- Sun Chemical Environmental, Health and Safety Policy, July 11, 2011
- SunCare Incident Investigation Report, January 17, 2011

- SunCare Procedure HSE 065, Combustible Dust, September 12, 2011, SUN00004089
- SunCare Procedure HSE 070, Emergency Contingency Plan
- SunCare Procedure HSE 193, *Management of Change Procedure*
- US Chemical Safety Board, US Ink/Sun Chemical Corporation, Ink Dust Explosion and Flash Fires in, East Rutherford, New Jersey, No. 2013-01-I-NJ.
- USICSB-E-00008009 - 00008038
- USICSB-E-00008031